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Prospect of Co. Richard Wolf Laparoscopic Surgical Instruments, [?B1 S1] (Front and back side) [?1982];
DE-Z: [?Testing Dept.], 13 Jg., H.2 1954, Pgs. 82 – 95;

Device for carrying out a minimally invasive surgery

This device is intended for carrying out a minimally invasive laparoscopic procedure with the use of surgical instruments inserted in the surgical field (19, 20) with help of several trocar adapters (11, 12), at least one endoscope and a monitor (25) for the visual observation of the operating field.
The system is distinguished by a camera stand (10), arranged above the operating table (1) consisting of several mounting installations (31, 32) for the trocar adapter (11, 13) inserted surgical instruments (19, 20) via the power transfer affecting elements (40) equipped with remote control and that for the remote control operated surgical instruments (19, 20) intended manipulator (31, 32) acting through the power transfer (40) and a monitor (35) comprising a control unit (30) at a spatial distance of at least 1 meter from the operating table is planned.

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[Illegible numbers within circles have been omitted, words in brackets with ? not clearly legible]

Description

The invention concerns a device for carrying out a minimally invasive laparoscopic procedure with the use surgical instruments inserted into the surgical field with help of several trocar adapters, at least one endoscope, and a monitor for the visual observation of the operating field.

In a minimally invasive surgical procedure, several trocar adapter surrounded trocars are inserted through a small incision each into a carbon dioxide filled body cavity. After the withdrawal of the trocars, through the trocar adapters, one or more endoscopes, as well as the operating tools in form of small instruments for cutting, grasping, and occluding, which will be used for the operation with the observation of the operating field on the monitor, are inserted. The specific advantages of the minimally invasive surgery are that large unsightly post surgical scars, excessive loss of blood and long bed rest after the operation can be avoided.

A device of the above noted type is, for example, known from the 1992 prospects of the Richard Wolf firm "Laparoscopic Surgical Instruments". In case of this well known instrumentation, the operating tools are extended instruments with hand control grips at one end and the actual instruments at the other end. These instruments are directly controlled by the surgeon who, not only controls the movement of these working tools with his hand, but also determines the position of the appropriate trocar adapters. For the surgeon, this type of equipment is quite awkward and the handling of the surgical instrument very complicated. Additionally, the expense for such system required for the operation and the elbow room required by the surgeon makes the needed assistance by the surgical assistant and nurses more difficult.

A stereo tactical device for brain surgery is known from the DE 28 09 645 C2 in which a stand with mounting installation above the operation table with a sliding channel adapter is intended for an operation field. With this type of device, intended for operations on static body parts such as a head or neck, the body part is fixed, for example, with point provided screws acting on the cranial vault. The endoscopes as well as the surgical instruments are inserted through the channel adapter equipped at the front end with a cone type [?compressing] and spreading [illegible]. The surgeon works through the endoscope with the surgical instruments in the immediate vicinity of the patient.

The basis for the invention is to make available a device for [?accurate] type insertion which would make the work of the surgeon and operating room personnel easier and also reduce the risk of internal injuries with the use of versatile trocar adapters.

This task has been solved by the subject matter in Claim 1.

That will enable the surgeon to concentrate fully on the handling of the actual instruments without running the danger that the required movement of hands and arms might involuntarily change the [sensitive] position of the trocar adapters, specifically, because the trocar adapters are firmly fixed on the stand in a desired position. Thus the surgeon does not need to counteract the actual operation movements by a specific counter force. Additionally, the surgeon will not be impeded by the assistants and other operating room personnel but will have a full freedom of motion for carrying out the operation.

The further on indicated claims explain the performance procedures of the inventions.

It is especially advantageous when the individual handling the instrument controls is trained to the extent that the surgeon's finger movements correspond to the desired movements of the surgical instruments. The strength and movements exercised on the controls should substantially correspond to the strength and movements that the surgeon would use with conventional instruments. The control handling elements are, therefore, purposefully integrated in the handling of controls and developed to the extent that the of the surgeon's movements of hands and fingers are fundamentally transferred in this form to the surgical instruments. It is especially beneficial to pattern the controls and/or the force transfer elements that the surgeon's hand and finger movements are preferably transferred at a [?motion] ratio of 3 : 1 to 6 : 1 to the operating instruments.

For good reason, the stand on which the trocar adapters are attached is directly linked to the operating table.

In the following text the invention is explained in detail on basis of a performance example.

The drawings show the following:

Fig. 1 a cross section of the device in a schematic representation and

Fig. 2 a view of the Fig. 1 represented device.

The device above the operating table comprises an assembled stand 10, a control unit 30 for the surgeon and the force transfer elements 40 through which the control unit 30 transfers the surgeon performed movements to the surgical instruments.

The drawings represent a situation during an operation in which a patient 2, to be operated on, is lying on operation table 1 and the various trocar adapters 11, 12, and 13, are in their working position. In the laparoscopic procedure represented here, three or more trocars have been inserted through the patient's abdominal wall into the carbon dioxide expanded abdominal cavity. After positioning the trocars, the trocar adapters 11, 12, and 13, remain as guiding channels for the surgical tools at the desired position so that the anterior ends of the trocar adapters are positioned in front of the location of surgery. Next, a trocar is inserted while its trocar adapter 12 serves as a guiding channel for the endoscope which is equipped with a lighting device and recording optics. The image is transferred from the recording optics to a television camera, which converts the electric signals. A monitor 14, positioned near the operating table at which the endoscope signal line is directed, makes it easier for the surgeon to insert the additional trocars through the abdominal wall at the location of the surgery with the trocar adapters 11 and 13, which are necessary for the surgical tools.

Linked to the operating table 1 is the stand 10 which, as the holding equipment for the trocar adapters 11, 12, and 13 and also the mount 16, are arranged on the anchorage system 17 where the mounts 16 on the anchorage bars 17 allow for any desired position through suitably flexible joints and can be fastened in any position to the appropriate anchorage system.

Additionally, arranged on the stand 10 are support for hanging or storage, which serve for storing of the surgical tools 19 and 20 conducted through the trocar adapters 11 and 13. The surgical instruments must be arranged in such manner that they allow for the required movement of the tools or instruments in the entire operating field. Otherwise, they must be developed in an autogenic inhibition, that means that the instruments always remain in the *position indicated for them by the surgeon*. In details, the construction of the suspensions and storage devices can be completed in various ways with the know machine elements.

The control of the surgical instruments by the surgeon, after their insertion in the trocar adapter 11 and 13, occurs through the control unit 30 which is located [?for example] at a distance of 1 to 3 m from the operating table. The control unit 30 is also the working position of the surgeon and comprises the actual control elements 31 and 32 for the surgical tools and a monitor 35 for visual observation of the operating field.

The control of the surgical instruments by the surgeon can basically be developed in any desired way to the extent that it will allow to carry out the necessary manipulation with the surgical tools. A surgical tool, for example, consists of a gripping device in form of a miniaturized simulation of a human hand with three grip fingers. Other surgical instruments are equipped for surgical punctures and provide for carrying out of incisions, coagulation procedures, flushing, suction, making sutures, etc. The sutures could also be carried out with two tools in which one of the instruments must be suitable for holding the needle. Making of a knot will be replaced by placing an adapter over both thread ends whereby both thread ends pulled through a knot will be tied by pushing of an adapter, which causes them to be *melded or be glued* together. All these required movements of the operating tools must be capable of being carried out through the control elements.

The control elements 31 and 32 in the represented performance example are completed by handling them in the form of gloves which have been developed in such way, that the surgeon's finger movements, as far as possible, correspond to the desired movement of the surgical instruments. The viewing direction of the surgeon at the monitor 35 and the movement direction of the gloves 31 and 32 are in the same direction. For this purpose, the optical axis of the endoscope in the trocar adapter 12 must be purposefully parallel to the direction of the surgical instrument selected trocar adapters 11 and 13.

In addition to the handling gloves 31 and 32, support envelopes 33 and 34 are arranged to support the surgeon's lower arms. These support envelopes 33 and 34 are flexibly mounted at horizontal levels in a way that will make it easier to handle the control elements. Simple functions, for example, switching on and off can be performed by foot pedals, which are not shown in the drawing.

Since the field of operation is quite limited, the rise of the surgeon's hand movements to the surgical instrument movement ratio is about 5 : 1.

The control gloves 31 and 32 transfer their movement, for example, in a mechanical way over the bars 36 and 37 and over the mechanical power transfer elements 40 to the surgical instruments. The bars 36 and 37 are flexibly linked for this purpose to a frame [?38].

As a matter of course, it is also possible to use equivalent electrical or pneumatic means instead of mechanical power transmission.

Patent Claims

1. This device is intended for carrying out a minimally invasive laparoscopic procedure with the use of surgical instruments inserted in the surgical field (19, 20) with help of several trocar adapters (11, 12), at least one endoscope and a monitor (25) for the visual observation of the operating field. The system is distinguished by a camera stand (10), arranged above the operating table (1) consisting of several mounting installations (31, 32) for the trocar adapter (11, 13) inserted surgical instruments (19, 20) via the power transfer affecting elements (40) equipped with remote control and that for the remote control operated surgical instruments (19, 20) intended manipulator (31, 32) acting through the power transfer (40) and a monitor (35) comprising a control unit (30) at a spatial distance of at least 1 meter from the operating table is planned.

2. The device under Claim 1 is distinguished by a stand (10) directly linked to the operating table (1)

3. The device under Claim 1 or 2 is distinguished by a stand (10) a suspension and storage assembly (18) arranged for storing the trocar adapters (11 and 13) for passing through the surgical tools (19 and 20).

4. The device under Claim 1 through 3 is distinguished in that the moving parts and their storage are developed with an autogenic inhibition, which means that the instruments always remain in the position indicated for them by the surgeon.

5. The device under Claim 1 through 4 is distinguished by integrated control elements (31, 32) of the manipulator in the control gloves and developed in such way that the movement of the surgeon's fingers correspond fundamentally to the desired movement of the surgical instruments (19, 20).

6. The device under Claim 1through 5 is distinguished by the control unit comprises two flexibly seated support envelopes (33, 34) for supporting the lower arms of the surgeon.

7. The device under Claim 1 through 6 is distinguished in that the power transfer elements (40) between the control unit (38) and the surgical tools (19, 20) consist of mechanized transfer elements.

8. The device under Claim 1 through 6 is distinguished by the power transfer from the control unit (38) to the surgical tools (19, 20) are intended to be by electric or pneumatic means.

Attached are 2 pages of drawings